Conducted Emissions / Interference

Company:	Zebra/Atlantek		Model #:	P640i	
Engineer:	Nicholas Abbondante	Barometer: BAR2	Serial #:	EM19	
Project #:	3072558	Pressure: 1002mB	Receiver:	HP 8542E (REC2/RECFL2)	
Date:	03/01/05 04/29/05	Temp: 17c	Cable:	CBL022 11-17-2005.cbl	
Standard:	FCC Part 15.207	Humidity: 33%	LISN 1, 2:	LISN11 [1] 6-06-05.lsn	LISN11 [2] 6-06-05.lsn
Class:	-	Group: None	LISN 3, N:	NONE.	NONE.
			Attenuator:	DS22A 11-17-2005.att	Location: Site 2

Voltage/Frequency: 230V/50Hz Frequency Range: 150 kHz - 30 MHz

Net is the sum of worst-case lisn, cable, & attenuator losses, preamp gain, and initial reading

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Net dB(uV)	QP Limit dB(uV)	Margin dB	Bandwidth
QP	0.183	30.2	41.5			64.0	64.4	-0.4	9/30 kHz
QP	0.487	0.3	30.0			51.4	56.2	-4.9	9/30 kHz
QP	9.202	10.7	9.3			31.3	60.0	-28.7	9/30 kHz
QP	15.700	23.4	19.8			44.2	60.0	-15.8	9/30 kHz
QP	24.000	13.7	11.3			34.7	60.0	-25.3	9/30 kHz
QP	29.950	-0.7	14.1			35.3	60.0	-24.7	9/30 kHz

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Net dB(uV)	Average Limit dB(uV)	Margin dB	Bandwidth
AVG	0.183	26.0	24.7			48.3	54.4	-6.0	9/30 kHz
AVG	0.487	-4.9	9.6			31.0	46.2	-15.3	9/30 kHz
AVG	9.202	4.3	2.8			24.9	50.0	-25.1	9/30 kHz
AVG	15.700	-6.9	13.4			34.3	50.0	-15.7	9/30 kHz
AVG	24.000	11.0	10.3			32.0	50.0	-18.0	9/30 kHz
AVG	29.950	-4.2	1.7			22.9	50.0	-27.1	9/30 kHz

Conducted Emissions / Interference

Company:	Zebra/Atlantek		Model #:	P640i	
Engineer:	Nicholas Abbondante	Barometer: BAR2	Serial #:	EM#19	
Project #:	3072558	Pressure: 1001 mB	Receiver:	HP 8542E (REC2/RECFL2)	
Date:	04/29/05	Temp: 19c	Cable:	CBL022 11-17-2005.cbl	
Standard:	FCC Part 15.207	Humidity: 32%	LISN 1, 2:	LISN11 [1] 6-06-05.lsn	LISN11 [2] 6-06-05.lsn
Class:	-	Group: None	LISN 3, N:	NONE.	NONE.
			Attenuator:	DS22A 11-17-2005.att	Location: Site 2

Voltage/Frequency: See Notes Frequency Range: 13.56 MHz

Net is the sum of worst-case lisn, cable, & attenuator losses, preamp gain, and initial reading

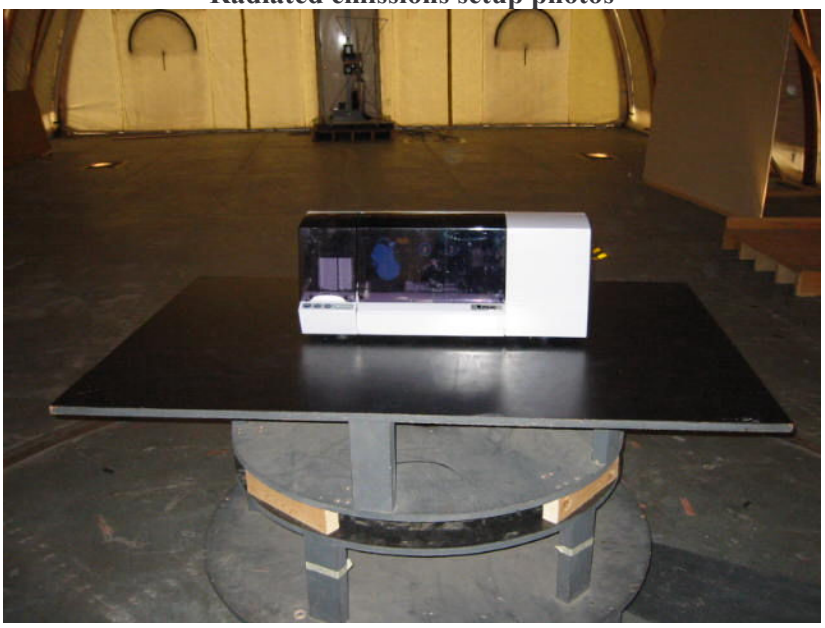
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Net dB(uV)	QP Limit dB(uV)	Margin dB	Bandwidth
120V/60Hz; RFID Antenna replaced with a 50 Ohm load									
QP	13.560	20.8	26.5			47.3	60.0	-12.7	9/30 kHz
230V/50Hz; RFID Antenna replaced with a 50 Ohm load									
QP	13.560	20.9	23.8			44.6	60.0	-15.4	9/30 kHz

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Net dB(uV)	Average Limit dB(uV)	Margin dB	Bandwidth
120V/60Hz; RFID Antenna replaced with a 50 Ohm load									
AVG	13.560	11.3	17.3			38.1	50.0	-11.9	9/30 kHz
230V/50Hz; RFID Antenna replaced with a 50 Ohm load									
AVG	13.560	14.3	15.9			36.7	50.0	-13.3	9/30 kHz

Test data taken at the RFID fundamental frequency with a 50 Ohm dummy load in place of the antenna.

Radiated emissions setup photos



Line-Conducted emissions setup photos

4.0 Test Results: Pass

4.1 Test Standard: FCC CFR47 Part 15 Subpart C Section 15.225

4.2 Test: Frequency Stability

4.3 Test Environment:

Temp: -20 - +50 °C
Voltage: 102V and 138V

4.4 Maximum Test Disturbance Parameters: The transmit frequency must not deviate from its nominal frequency at room temperature and nominal voltage by more than 0.01%.

Test Date: 3/14/2005 **Test Engineer Initials:**_____**Date:**_____
Test Engineer: Nicholas Abbondante **Reviewer Initials:**_____**Date:**_____

4.5 Test Equipment Used:

Intertek ID	Manufacturer	Model	Serial Number	Cal. Due
SAF095	Fluke	87	65981460	07/01/2005
SAF418	Powerstat	3PN126	N/A	Verified using SAF095
SA0001	Hewlett Packard	8591E	3308A01445	07/23/2005
SAF187	Bryant Manufacturing	TH-5S	1207	04/06/2005

4.6 Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3

4.7 Test Results:

Frequency Stability 3/14/2005

Temp celsius	EUT Freq MHz	EUT Deviation MHz	EUT % Deviation	Max MHz Drift
-20	13.5586	-0.00015	-0.0011063	0.001355875
-10	13.5587	-5E-05	-0.0003688	0.001355875
0	13.5586	-0.00015	-0.0011063	0.001355875
10	13.5586	-0.00015	-0.0011063	0.001355875
20	13.55875	0	0	0.001355875
30	13.55845	-0.0003	-0.0022126	0.001355875
40	13.55835	-0.0004	-0.0029501	0.001355875
50	13.55835	-0.0004	-0.0029501	0.001355875

Voltage, Volts	EUT Freq MHz	EUT Deviation MHz	EUT % Deviation	Max MHz Drift
102V	13.55845	-0.0003	-0.0022126	0.001355875
138V	13.5585	-0.00025	-0.0018438	0.001355875

4.0 Test Results: Pass

4.1 Test Standard: FCC CFR47 Part 15 Subpart C Section 15.225

4.2 Test: Frequency Stability

4.3 Test Environment:

Temp: -20 - +50 °C
Voltage: 102V and 138V

4.4 Maximum Test Disturbance Parameters: The transmit frequency must not deviate from its nominal frequency at room temperature and nominal voltage by more than 0.01%.

Test Date: 3/14/2005 **Test Engineer Initials:** NNA **Date:** 6/1/05
Test Engineer: Nicholas Abbondante **Reviewer Initials:** VFV **Date:** 6/6/05

4.5 Test Equipment Used:

Intertek ID	Manufacturer	Model	Serial Number	Cal. Due
SAF095	Fluke	87	65981460	07/01/2005
SAF418	Powerstat	3PN126	N/A	Verified using SAF095
SA0001	Hewlett Packard	8591E	3308A01445	07/23/2005
SAF187	Bryant Manufacturing	TH-5S	1207	04/06/2005

4.6 Software Utilized:

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EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3

4.7 Test Results:

Frequency Stability 3/14/2005

Temp celsius	EUT Freq MHz	EUT Deviation MHz	EUT % Deviation	Max MHz Drift
-20	13.5586	-0.00015	-0.0011063	0.001355875
-10	13.5587	-5E-05	-0.0003688	0.001355875
0	13.5586	-0.00015	-0.0011063	0.001355875
10	13.5586	-0.00015	-0.0011063	0.001355875
20	13.55875	0	0	0.001355875
30	13.55845	-0.0003	-0.0022126	0.001355875
40	13.55835	-0.0004	-0.0029501	0.001355875
50	13.55835	-0.0004	-0.0029501	0.001355875

Voltage, Volts	EUT Freq MHz	EUT Deviation MHz	EUT % Deviation	Max MHz Drift
102V	13.55845	-0.0003	-0.0022126	0.001355875
138V	13.5585	-0.00025	-0.0018438	0.001355875

Emissions Site Description:

Site 2C (Middle Site) is a 3m and 10m sheltered emissions measurement range located in a light commercial environment in Boxborough, Massachusetts. It meets the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal ground plane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity is provided for floor-standing equipment. A wooden table 80 cm high is used for tabletop equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the ground plane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical ground plane (2 meter X 2 meter area) is used for line-conducted measurements for tabletop equipment. The vertical ground plane is electrically connected to the reference ground plane.

Parking Lot – Magnetic field emissions testing below 30 MHz is performed in the asphalt parking lot located next to site 2. There is no ground plane.

Measurement Uncertainty:

Note that the measurement uncertainty contained herein is ±4.0 dB for radiated emissions and ±2.0 dB for line-conducted emissions.

The following is how net radiated field strength readings were determined:

NF = RF + AF + CF - PF - AVF - DF

Where, NF = Net Reading in dBμV/m
RF = Reading from receiver in dBμV
AF = Antenna Correction Factor in dB(1/m)
CF = Cable Correction Factor in dB
PF = Pre-Amplifier Correction Factor in dB
AVF = Duty Cycle Correction Factor in dB (only if applicable)
DF = Distance Factor in dB (using 20 dB/decade unless otherwise specified)

To convert from dBμV/m to μV/m or mV/m the following was used:

$UF = 10^{(NF / 20)}$

Where, UF = Net Reading in μV/m

Example:

NF = RF + AF + CF - PF - AVF - DF = 62.9 + 13.7 + 2.1 - 16.1 - 0.0 - 10.5 = 52.1 dBμV/m

$UF = 10^{(52.1\ dB\mu V / 20)} = 403\ \mu V/m$

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF

Where, NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$

Where, UF = Net Reading in μV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV

$UF = 10^{(48.1\ dB\mu V / 20)} = 254\ \mu V/m$